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CHEMICAL & ENGINEERING

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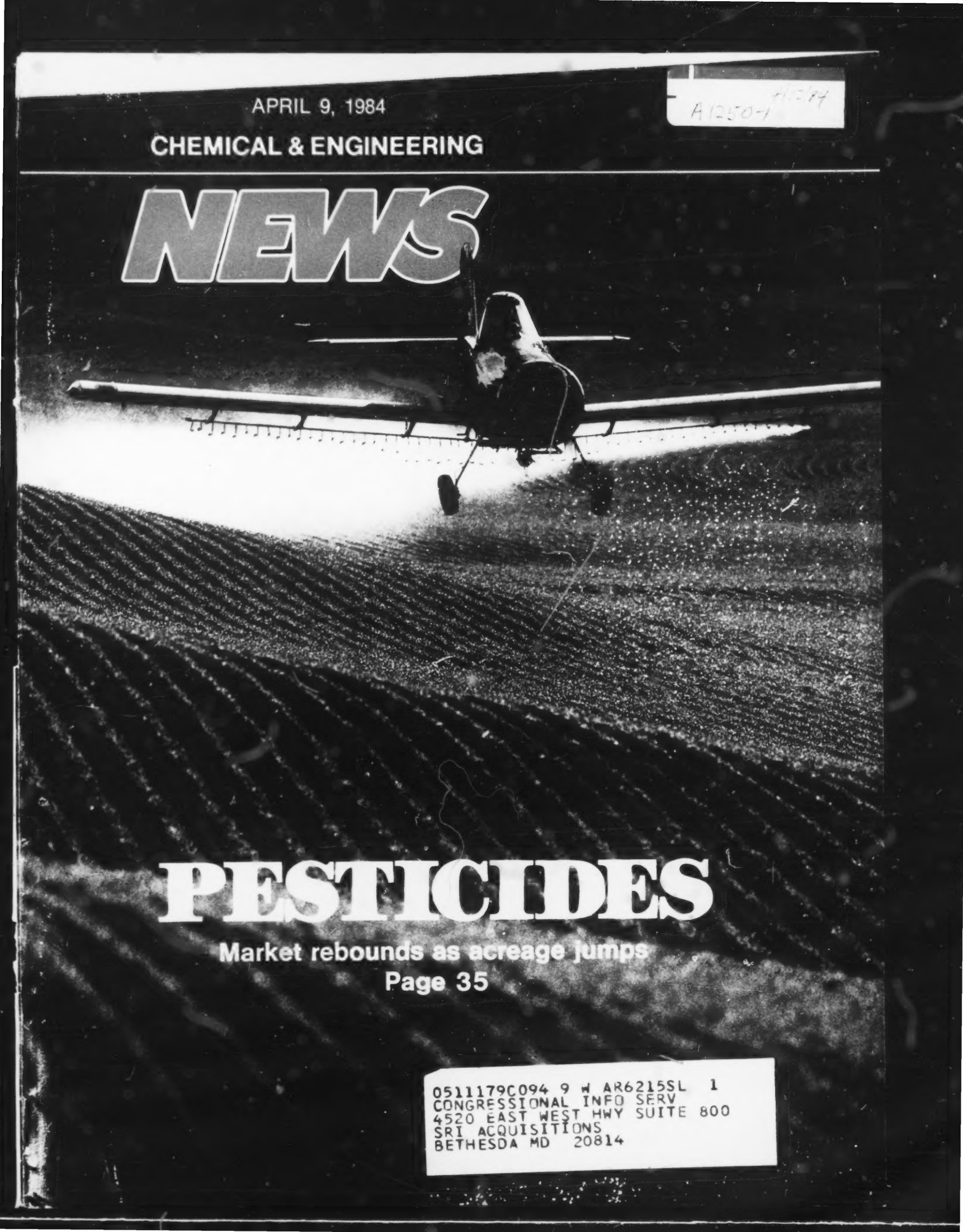

PESTICIDES

Market rebounds as acreage jumps

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Cover: Aerial spraying of Du Pont herbicide on wheat crop in Washington state

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News of the Week

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Business

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Government

EPA cost-benefit study of effects on health and the environment of eliminating lead additives in gasoline predicts savings of nearly a quarter of a billion dollars by 1988. **Page 18**

Science

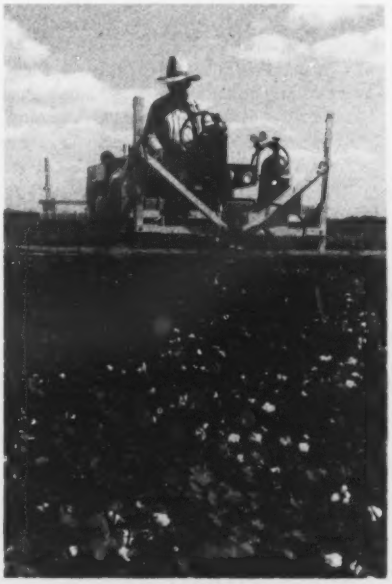
Theories concerning oxygen toxicity and role of proteins called superoxide dismutases are crux of scientific debate. **Page 20**

Education

The Institute for Chemical Education, set up at the University of Wisconsin, Madison, aims to develop creative ideas to convey chemical knowledge, improve interdisciplinary links. **Page 28**

ACS News

***Chemical Abstracts* publishes its 10 millionth abstract** only 13 years after the 5 millionth appeared; in contrast it took almost 32 years for *CA* to produce the first million. **Page 61**



Pesticide Report

Pesticide makers expect a good year—crop acreage will improve and farm prices rise from last year's low. **Page 35**

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AAAS R&D ANALYSIS: Federal funding vulnerable to cuts

The American Association for the Advancement of Science's ninth annual report on R&D, the focal point of a recent colloquium, is a gloomy document. Although admitting that the Administration's proposed budget is strong for R&D, the report says that this is overshadowed by the need for drastic actions to reduce the deficit.

The report reiterates the by-now-familiar points that the big R&D increase is almost entirely on the military side, whereas the nondefense R&D budget increases only about as much as inflation; that there are larger increases for research in the physical sciences and engineering than for biological and medical sciences; and that programs in areas considered to be private-sector responsibilities are again recommended for drastic cuts or termination.

And it concludes that the President's budget, instead of being a plan for dealing with the problems of the nation, is rather "a statement of the problem, with the answers left up in the air—to be found in bipartisan negotiations with Congress, unilateral Congressional actions, or a new Presidential initiative sometime after the elections. However it comes, the answer will result in a new budget, markedly different from the present fiscal 1985 budget. Some combination of tax increases, other new revenues, and major surgery on the expenditure side seems inevitable."

The report points out that R&D will be in an exposed position for deficit-control budget cutting: defense R&D because it is a "controllable" part of the largest, single "controllable" class of expenditures in the budget, and nondefense R&D because it represents such a large "controllable" part (20%) of total expenditures for nondefense programs.

At the colloquium, Presidential Science Adviser George A. Keyworth II took exception to the report's assumption that the R&D priorities in the budget "will be thrown out the window during an inevitable orgy of budget cutting down the road." And he questioned what he sees as the report's implication that changes in research funding priorities are inherently bad.

Keyworth contends that most of the increases in defense R&D come from development costs associated with the modernization of the nation's strategic forces—an action needed to restore strength that was eroded during the previous decade. On the other hand, he says, the flat curve in civilian R&D reflects two countervailing trends—a steady drop in development and a steady rise in basic research, which has grown from the smallest fraction of nondefense R&D to the largest. Keyworth also points out that since 1981, support for university R&D, which had been essentially flat, has grown 26% in real terms.

The section of the report that deals specifically with chemistry, prepared by Le-Nhung McLeland and Annette T. Rosenblum of the American Chemical Society's Office of Public Affairs, is generally upbeat, finding that the proposed budget is favorable for basic research in chemistry, particularly academic research. Among the highlights is that for the first time in years the National Science Foundation's chemistry division expects the number of grants awarded to increase by 50 and the average award amount by almost $8000.

Copies of the report are available from the AAAS Sales Office, 1515 Massachusetts Ave., N.W., Washington, D.C. 20005. The price is $10. □

Funding for programs supporting chemistry up almost 11%

$ Millions	1985[a]	1984[a]	1983[b]	% change 1984–85
NSF	**$206.3**	**$180.7**	**$162.2**	**14.2%**
Chemistry	92.1	80.0	67.6	15.1
Materials	66.5	57.5	46.9	15.8
Other	47.7	43.2	47.7	10.4
DOD[c]	**153.8**	**144.8**	**139.9**	**6.2**
Materials	87.5	82.8	81.0	5.7
Chemistry	66.3	62.0	58.9	6.9
EPA	**132.9**	**110.7**	**108.?**	**20.0**
Extramural R&D	100.1	81.9	71.4	22.2
In-house R&D	32.8	28.8	36.7	13.9
Energy	**104.4**	**96.9**	**90.6**	**7.7**
Chemical sciences	80.9	75.5	70.0	7.1
Materials chemistry	14.8	13.4	12.3	?0.4
Nuclear sciences—heavy element chemistry	5.1	4.7	4.4	8.5
Geochemistry	3.6	3.3	3.9	9.1
NBS	**40.6**	**42.5**	**41.2**	**−4.5**
TOTAL	**$638.0**	**$575.6**	**$542.0**	**10.8%**

a Estimate. b Actual. c Funds classified under budget category "6.1." **Note:** Chemistry support by NIH not included because of the difficulty of breaking out the actual amounts.

Additives Widen Refiners' Options in Making Gasolines

Oxygenated compounds along with metal antiknocks, toluene, and processing methods complicate cost estimating for refiners

Petroleum refiners making gasolines are looking harder than ever at their costs. Many more options than a decade ago are now available to refiners and blenders of gasolines to use in making the various grades of gasoline.

These options range from conventional processing—for example, catalytic cracking and reforming—to use of lead alkyls, oxygenated hydrocarbons, and other hydrocarbons to gain desired octane values. George H. Unzelman, technical director of Ethyl Corp.'s petroleum chemicals division, and George W. Michalski, manager of refinery technology of the division, assessed these options for refiners at the 82nd annual meeting of the National Petroleum Refiners Association held recently in San Antonio, Tex.

Refiners use various kinds of linear programing models to evaluate octane costs under varying conditions of crude oil acquisition costs, processing costs, additives, and overheads. The gasoline pool remains the critical money-maker in most refineries. The antiknock additives are the last increment of flexibility in blending gasolines to specifications and controlling costs.

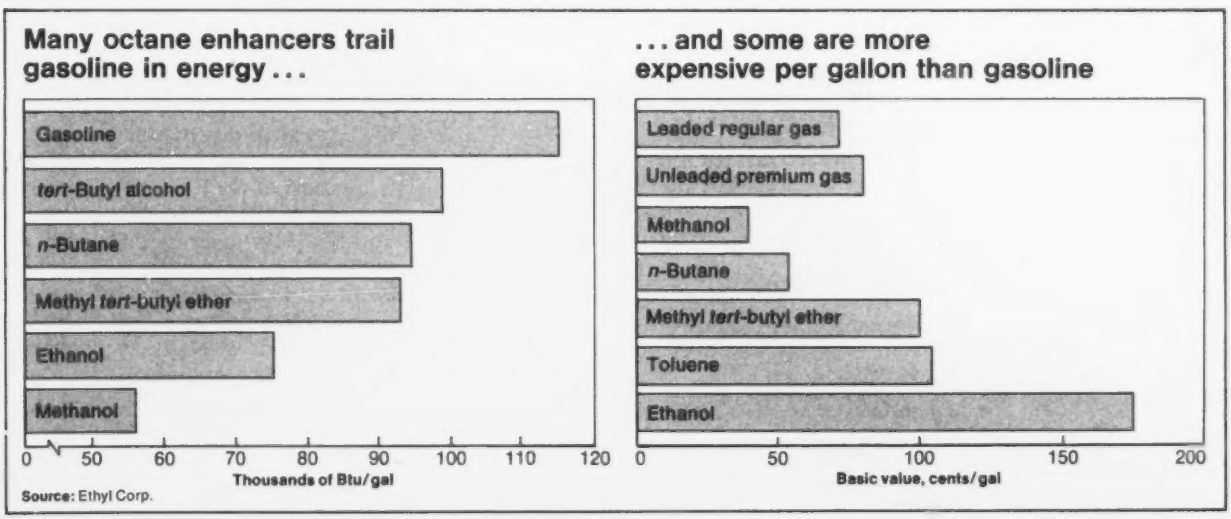
Lead alkyls remain the lowest-cost way of increasing octane value, but their use is becoming more and more limited by government regulations. Another additive, manganese in the form of methylcyclopentadienyl manganese tricarbonyl, also has been used for some time.

Currently growing in importance as additives to obtain desired octane values are the oxygenated hydrocarbons—such as alcohols, methyl *tert*-butyl ether, and blends of these materials—and toluene. However, various Clean Air Act and Environmental Protection Agency regulations limit the amount of oxygenates or oxygen allowed in gasolines. Much controversy has developed over the effect of oxygenates in gasolines on drivability, their compatibility with fuel system components, and the like.

Of the various oxygenates, methyl *tert*-butyl ether (MTBE) has blending characteristics close to those of the hydrocarbons in gasolines. For this reason, it is the only oxygenate generally accepted for blending and subsequent transport of the gasoline through pipelines, Unzelman and Michalski point out.

Use of fuel-grade ethanol in gasoline has increased rapidly. Ethyl estimates that more than 300 million gal of fuel-grade ethanol were used in 1983. However, this amount, equivalent to about 20,000 barrels a day, is about 0.3% of the more than 6.2 million bbl a day of gasoline sold.

Methanol, currently in excess supply, causing its price to be down to barely profitable levels for most producers, can be used in leaded gasolines. But so far EPA has not granted waivers for its use in un-



Cost of using octane boosters varies widely

	Volume %	Cents ONB[a] Unleaded regular	Unleaded premium	Leaded regular
Ethanol, at 176¢/gal	10%	155.4¢	177.6¢	201.8¢
with 5¢/gal subsidy	10	79.8	88.2	105.9[b]
with 10¢/gal subsidy	10	4.3	−1.2	10.0[b]
Ethanol at 176¢/gal	5	173.9	195.0	231.4
***tert*-Butyl alcohol**	16	81.2	114.2	66.1
Methyl *tert*-butyl ether at 100¢/gal	11	45.1	49.0	41.7
at 100¢/gal	4	48.8	52.6	45.2
Toluene at 105¢/gal	4	48.6	53.7	44.0
Methanol at 40¢/gal	5	−19.0	−17.2	−29.2
at 70¢/gal	5	35.8	35.7	51.6

a Octane Number Barrel, or raising one barrel of gasoline's octane value by one number. b Assumes that gasohol subsidy applies to leaded gasoline. **Note:** Negative numbers show cost saving over pure gasoline. **Source:** Ethyl Corp.

leaded gasolines without a cosolvent. Cosolvents are used with methanol to minimize water-methanol phase separation from the rest of the hydrocarbons in gasolines. *tert*-Butyl alcohol is by far the most common cosolvent and has been used alone in a blend with minor amounts of compounds as an additive.

Of the commonly used additives to increase octane values of gasolines, lead alkyls cost the least, toluene and MTBE the most. Calculations for estimating cost of octane improvement are more complex when using blending agents such as the oxygenates or toluene, according to Ethyl. Important factors are volume, vapor pressure, and finished cost. The volume of a blending agent to improve octane value can be relatively large if compared to an antiknock. Vapor pressure requirements can mean that adding a volatile blending agent such as methanol can cause less *n*-butane to be added to a gasoline with a credit for less *n*-butane used but a penalty for loss of the relatively high octane value of *n*-butane. Subsidies in the form of tax exemptions of 5 to 116 cents per gal of gasoline containing 10% ethanol are the equivalent of 50 cents to $1.60 per gal credit. □

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EPA Study Backs Cut in Lead Use in Gas

Recently the Environmental Protection Agency's Office of Policy Analysis quietly released for public comment a study that concluded the U.S. could reap health and environmental benefits totaling nearly a quarter of a billion dollars or more if all or nearly all lead were removed from gasoline by 1988.

Except perhaps for fluoridation of water and creationism, nothing raises the dander of affected groups faster than the issue of lead. And EPA's study quickly elicited both accolades and brickbats. Former Carter EPA official William Drayton, who is now chairman of an environmental health coalition called the American Environmental Safety Council, says this study is "one of the highest quality staff studies I've seen." Vice chairman of the board of Ethyl Corp. Lawrence E. Blanchard Jr. says that a "juvenile and simplistic approach is now being taken by EPA to justify their efforts to further reduce lead in gasoline." Ethyl is the nation's largest producer of tetraethyllead, used to boost the octane rating of gasoline.

Unfortunately for Ethyl, the usual stumbling block within the Reagan Administration for pro-environmental regulatory changes agrees with Drayton. Says the Office of Management & Budget's administrator for information and regulatory affairs Christopher C. DeMuth: EPA's economic analysis "is a model of how regulatory issues in the health area ought to be approached." He challenges Ethyl to "go beyond denunciations and tell us where the study is wrong."

Ethyl will have to act swiftly because EPA soon is expected to propose a revised lead-in-gasoline regulation under the mantle of the Clean Air Act. Several weeks ago EPA Administrator William D. Ruckelshaus said his agency was considering a rule banning all lead use in gasoline by 1988. More likely, however, is a regulation lowering the lead content of gasoline from the current level of 1.1 g per gal to 0.1 g per gal by 1988.

Lead use level in gasoline was last lowered in 1982. The catalyst for that action was studies conducted by the Centers for Disease Control and the National Center for Health Statistics. These showed a direct correlation between lowered lead use in gasoline and lowered blood lead levels in all U.S. population sectors, but especially in the most sensitive group, children. The 1982 standard was estimated to lower blood lead levels below CDC's "undue lead absorption" level of 30 μg per deciliter. Above this level, there is damage to the kidneys, liver, reproductive system, blood-forming elements, basic cellular metabolism, and brain functions.

Since 1982, clinical studies have indicated adverse health effects at blood lead levels below CDC's current lead toxicity standard. And EPA has found that its 1982 lead phasedown campaign has been short-circuited by misfueling.

Use of leaded gasoline in catalyst-equipped vehicles poisons the catalysts and results in higher tailpipe emissions of conventional air pollutants, and more frequent tuneups, oil changes, and exhaust-system replacements. In fact, EPA's low-lead option (0.1 g per gal) would lead to maintenance benefits of $660 million, and a ban on lead would lead to maintenance savings of $755 million by 1988. Eliminating misfueling would reduce the damage caused by conventional pollutants $404 million under either option. The low-lead option would reduce medical care costs $41 million and cognitive damage (including the loss of several IQ points) $184 million, whereas an all-out lead ban would reduce these costs $43 million and $193 million, respectively.

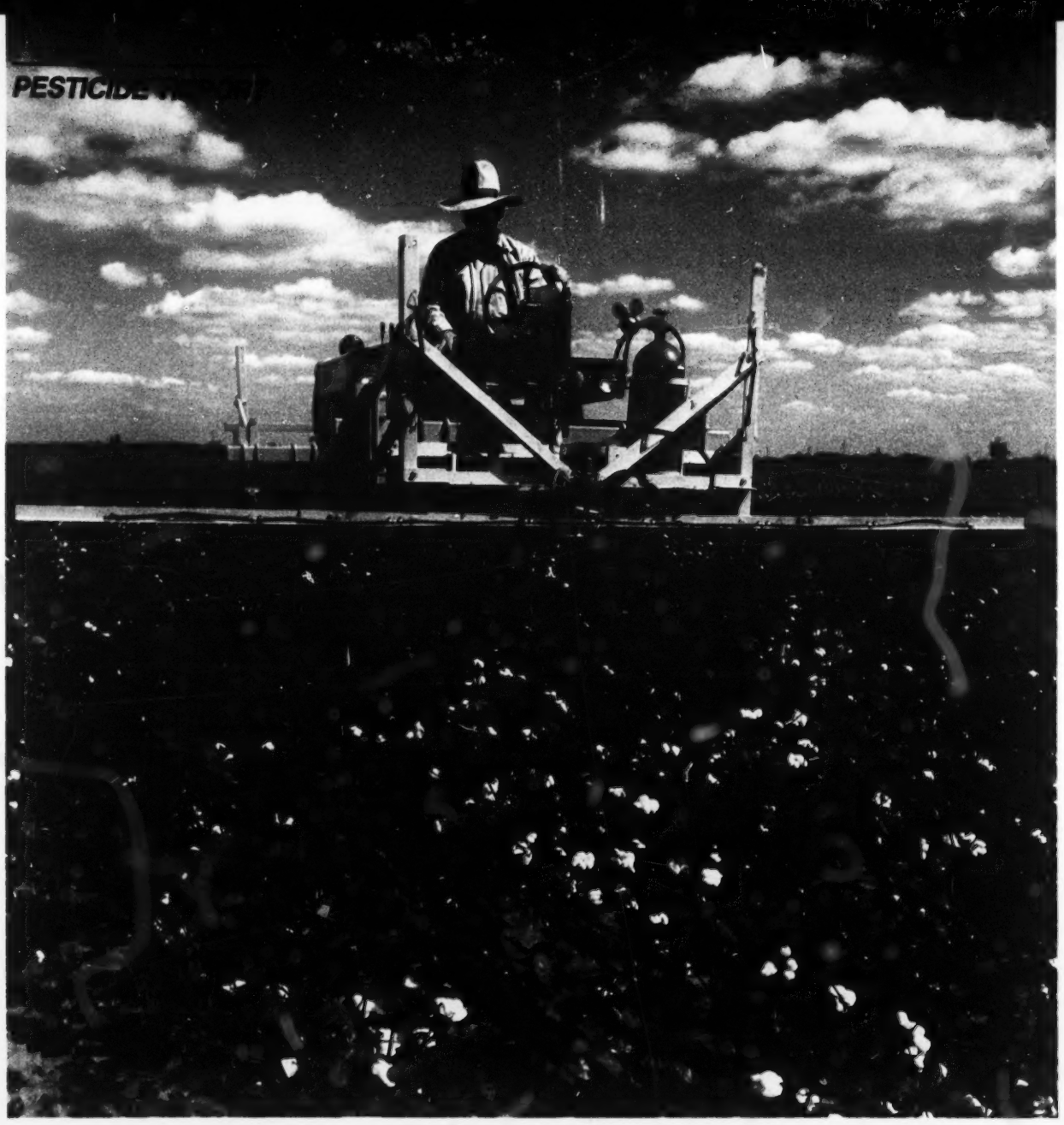
On the cost side, the low-lead option would cost refiners $503 million, and the cost of the no-lead option would be $691 million in 1988. EPA could not predict future marketing strategies and, therefore, was unable to estimate the change in gasoline price to consumers.

Lois Ember, Washington

EPA's cost-benefit study at a glance

	Low-lead option[a]	All unleaded[b]
Total costs ($ millions, 1983)	$503	$691 + nonmonetized valve damage
Total benefits ($ millions, 1983)	$1,289 + nonmonetized health benefits	$1,395 + nonmonetized health benefits
Net benefits ($ millions, 1983)	$786 + nonmonetized health benefits	$704 + nonmonetized health benefits
Reductions in emissions (thousands of metric tons)		
Lead	33	36
Hydrocarbons	314	314
Carbon monoxide	2,202	2,202
Nitrogen oxides	130	130
Ozone (formed as result of HC and NO_x emissions)	1.5% reduction	1.5% reduction
Total reductions in number of children at risk of various adverse health effects	6,251,000	6,584,000

a 0.10 g of lead per gallon of gasoline available by 1988 to vehicles requiring some lead; assumes no misfueling.
b All lead in gasoline banned by 1988. Source: EPA's Office of Policy Analysis.



Pesticides Head for Recovery

William J. Storck, C&EN New York

In the U.S. today companies' fortunes can rise and fall on pesticide sales. For instance, much of Monsanto's profits over the past couple of years have come from its agricultural chemical operations. And Stauffer Chemical ran into trouble last year as the company's pesticide sales were adversely affected by government programs.

Last year was indeed trouble for pesticides. However, this year certainly promises much better times, as crop acreage improves and farm prices pick up.

In some ways, pesticides are still coming into their own. There is probably more research being done in this relatively small segment of the chemical industry than in any other with the exception of pharmaceuticals. No longer are the products crude poisons that could kill the plant as well as the pest. Instead, they are fairly narrow, specific acting control substances for weeds, insects, and other pests. And they are much more active compounds than in the past, with applications sometimes measured in ounces per acre rather than in pounds or tens of pounds as they were just a decade ago.

In fact, this increased specific ac-

Home and garden pesticides are a steady market

Pesticides for home and garden use were not immune from problems last year. However, the problems were mostly weather related, having nothing to do with government programs and little with the recession. In fact, home and garden pesticides are counterrecessionary since, as economic times get hard, people tend to increase vegetable gardening to raise more of their own food.

The problem last year was the weather, which was bad for gardening practically all across the country. Thus, shipments of home and garden pesticides dropped precipitously. But, producers say, this year likely will see a return to the traditional 4%-per-year growth for this small but important segment of the market. In fact, they say, in areas of the country where home gardens already are started there is spectacular growth in pesticide use over last year.

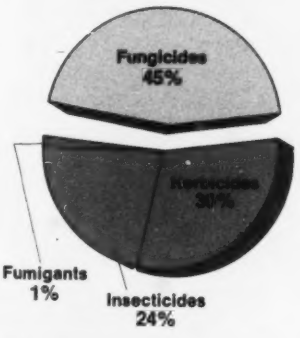
The market research firm Predicasts estimates that in 1982 about 97 million lb of herbicides, insecticides, fungicides, and fumigants valued at about $377 million were sold for home and garden uses.

Industry sources say that there are a number of reasons for the relatively slow but sure growth in the use of home and garden pesticides. Among these are the fact that more people are joining the gardening ranks because they believe they can save money and produce better vegetables at home than they can get in the store. And, they say, it's fun.

There is an irony in the garden use of pesticides, one industry spokesman says. It is, by and large, the people who believe that chemicals generally are in some way harmful who plant gardens, and yet, to protect their investment, they themselves are big users of pesticides.

Another reason for the growth is that people are upgrading the value of their properties by improving lawns and planting trees, shrubs, and flower gardens. This is a relatively inexpensive way to add value to a home. And finally, the people who don't own homes with lawns, but rather apartments or condominiums, are using more pesticides, primarily because of the increase in houseplants.

Fungicides are biggest-volume home pesticide



Total 1983 volume = 97 million lb

Sources: Predicasts, C&EN estimates

However, the future is not all rosy for the home and garden pesticide market. Predicasts forecasts that the decreased construction of single family homes will cause the home and garden market to level off after about 1987. And it sees little growth between 1987 and 1995. Growth is tied more to new housing starts than to product development.

There are problems, too, in simply developing new products. W. L. Shewry Jr., merchandising manager for Chevron Chemical's Ortho consumer products division, says that most of the products for home and garden use are developed by the large agricultural chemical companies. And these companies opt for registrations for the large cash crops first. This tends to cut off new product development for the home market because the cost of testing for registration is just too high for the small volumes involved. "There are no big developments in the consumer market," Shewry says.

There is, however, quite extensive toxicity testing in the home and garden market. Ortho, for example, maintains a toxicology laboratory and six testing stations. In addition, some testing is done in conjunction with the companies that have developed the product.

Another product restriction is that home owners tend to apply more pesticide than is called for. Thus, if the product is not safe at at least two to three times the recommended levels, companies just won't sell it.

As an example of the necessary lack of innovation in the industry, the largest-selling herbicide is probably the old standby, 2,4-D. And the largest-selling insecticides are Sevin, malathion, and diazinon—three traditional insect killers.

Producers say that eventually there will be new products, but because of the lack of commitment on the part of the agricultural chemical producers, the lead time before a product gets to the home and garden market is very long. Some of the new products introduced for agriculture today, one producer says, will not make it to the home and garden market until probably the turn of the century.

tivity is the primary reason for the decline in production in the pesticides industry. According to figures from the U.S. International Trade Commission, production of pesticides in the U.S. declined 21% between 1973 and 1982 to 1.11 billion lb. Because the new generation of pesticides is more active, not so much is needed on crops. Demand for pesticides tells much the same story, falling 16% to 1.15 billion lb in 1982.

The new generation of pesticides also is higher priced. During that same period between 1973 and 1982, the value per pound of pesticides rose almost 200% to $3.87. And, unlike production, the value per pound did not deline during the poor season of 1983, but stayed at its 1982 level. The result is that the value of pesticide sales during the decade increased 144% to $4.43 billion in 1982, according to ITC.

Last year, however, brought a halt to many of the favorable statistics counted on by pesticide manufacturers. Estimates are that production and demand skidded about 13 to 15% from 1982 levels and the value of those shipments was down about the same amount, as prices

Monsanto Agricultural Products Co. technician runs portion of residue tests required for registering new pesticides with government

remained flat with year-earlier levels.

There were several reasons for the slide. The first and probably most talked about was the government's Payment-In-Kind crop set-aside program. Under this program, planted crop acres were down about 14% to 255 million acres in 1983 from their 1982 level, according to Department of Agriculture figures. And two of the largest crops for pesticides—corn and cotton—had reductions in plantings of more than 25%. Even soybeans, the second largest crop in the U.S. behind corn, and exempt from the PIK program, saw an 11% reduction in crop acreage.

The weather also worked against pesticides last year. Some parts of the country had extremely cold, wet springs, delaying the planting season. This was followed by drought in the Midwest and South, which cut both herbicide and insecticide use through the summer.

Finally, the strength of the dollar compared with foreign currencies served to stifle exports of pesticides. Pesticide exports rose only 1.8% last year to a value of $1.29 billion from their 1982 level. This compares with an average annual growth rate over the past decade of a little more than 13% per year.

In a sense, exports are crucial to the fortunes of pesticide producers. They can take up to 50% of production in some areas and generally provide a buffer against economic downturns and vagaries in the weather in the U.S. And there is a large trade surplus in pesticides, with exports more than a billion dollars larger than imports in 1983.

This year, however, likely will be different, and pesticide demand may come close to matching that of 1982. The government's PIK program has been lifted, although there is still a set-aside program for corn. Producers say, therefore, if the weather cooperates it probably will be a normal year for pesticide use.

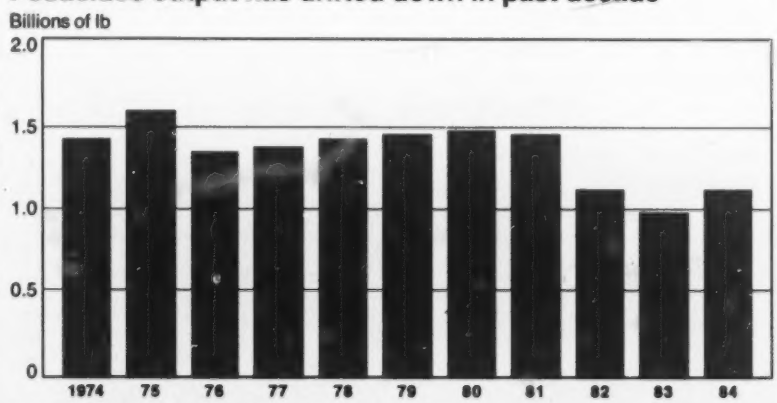
Farmers certainly are cooperating to make it a normal year for pesticide producers. USDA forecasts that crop plantings will be up sharply in 1984 from 1983. According to the government, corn acreage will rise 36% to 81.8 million acres this year. Cotton also will recover its loss, climbing 35% to 20.8 million acres from its level last year. USDA also says that soybean acreage will be up about 3% and wheat plantings will climb about 7.5%.

If USDA is right, even exports will get back on track, rising 9% to 218 million lb of active ingredients of fungicides, herbicides, and insecticides compared to 1983.

Though producers forecast an increase in total pesticides production in 1984, the government says that production of farm pesticides probably will decline in 1984 about 10% to 709 million lb. The reason for this is a large inventory carry-over caused by the poor season last year. According to the government figures, the inventory carry-over at the end of 1983 amounted to about 48% of that year's production.

The drop in production will result, of course, in a decline in capacity utilization. USDA says that capacity use for all pesticides will decline to about 47% in 1984 from 54% last year. As recently as 1982, pesticide plants had been operating at 80% of capacity. According to the government data, insecticide plants will be the worst off, running at about 35% of capacity, up from 33% last year. Herbicide operations will run at 54%, down from 66% in 1983. And fungicide plants will be going at 76%, up from 71%.

Pesticides output has drifted down in past decade



Sources: Department of Agriculture, C&EN estimates

Herbicides begin recovery from PIK program, other problems

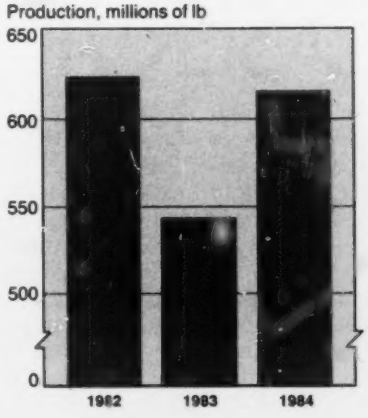
1983 was not a particularly good year for producers of herbicides. After a fairly steady rise in the value of herbicides shipments for more than a decade, sales suddenly dropped off.

The reasons for the fall were fairly obvious and to some extent expected. The government's payment-in-kind (PIK) program, which took a lot of agricultural acreage out of production, combined with a strong dollar, which to some extent throttled exports of herbicides, to play havoc with herbicide sales. Sales also were hurt by the recession and lower farm income. If all of this weren't enough, the weather conspired against the herbicide makers, giving them low rainfall in many parts of the country. And as one sales manager said, "If there is no rain, the weeds don't grow."

The PIK program was particularly hard on producers of herbicides for corn and cotton. These were two primary large crops included in the program. Soybeans were exempt from the program so that herbicides used on this crop did not suffer from the government policy.

Producers estimate that all of the problems taken together cut herbicide sales volume 13 to 15% last year to about 542 million lb from the 1982 level. The value of those sales was down 11 to 12%, since there was little price inflation in herbicides in 1983.

This year producers expect herbicides to recover about 90% of their losses as much of the government's PIK program ends. However, there is still a corn set-aside program, and



herbicide producers are betting that participation in this program will be fairly heavy. It is still too early to tell, because farmers do not have to sign up for the program until May. And the feeling is that most will wait until the last moment before making their decision. Financial penalties for withdrawing from the program once the farmer has signed up for it are fairly heavy.

Even though intentions for planting in most crops are up from last year, herbicide producers do not think plantings, at least in corn and soybeans, the two largest crops, will get back to 1982 levels. In 1982, farmers planted about 82 million acres of corn and about 70 million acres of soybeans. This year plantings of each of these crops still will be 2 million to 3 million acres below 1982 plantings.

Like most pesticides, herbicide inventories this year are slim. One producer goes so far as to say that stocks are in the best shape they have ever been in. There has been a trend to lower inventories at the dealer level over the past few years, as the high cost of money makes dealers cautious about just how much inventory they want to carry. Manufacturers say that inventories also can be kept lower because the distribution chain has been streamlined, allowing for faster delivery of product to the dealers.

Ultimately, however, this trend has forced the carrying of inventories back to the manufacturers' level, a situation that they say they do not mind very much. "It's still a receivable to us, no matter where it is," one sales manager says. Some herbicide makers have even gone so far as to let out product on consignment. In other words, the manufacturer owns the product until it is sold by the dealer, even if it is in the dealer's warehouse.

Prices for herbicides are expected to be pretty firm this year given the tight inventory situation and the forecasts for increased planting. Last year, the Department of Agriculture says, herbicide prices were down about 4% from the year before, but it blames this on the continuing erosion of the price of atrazine and the much ballyhooed price cut on Lilly's Treflan, which manufacturers say was a market aberration. They say that Lilly lowered the price simply because its patent on the product will soon expire.

Thus, compared with last year, 1984 is going to be a good one for herbicide producers. Still, it probably won't be much better than average.

Thus, the year may be good enough that producers will at least recover what they lost during 1983, although they won't be back to 1981 levels as yet. Producers forecast that herbicides will recover their losses, and insecticides may well do better than they did in 1982.

Demand for miticides, a product category sometimes classified with insecticides, also will bounce back in 1984. Miticide producers insist that their products differ from insecticides because mites are arachnids rather than insects and thus have a different morphology. The morphological differences between mites and insects are great enough that mites quickly develop resistance to insecticides. Hence the need for miticides.

Miticide sales suffered last year along with those of other pesticides, because acreage was down for field crops. Although the largest use for miticides is in fruit trees, which were not included in the government PIK program, the decline in field crop acreage did hurt, since cotton and corn make up a significant portion of the market for miticides.

Miticide producers expect the value of their products to increase about 4 to 5% annually over the next five years. This growth is slowed somewhat by older, first-generation products that are almost of a commodity class. However, producers say that the increase in the value could be much greater if the Environmental Protection Agency initiates regulatory action against Rohm & Haas' Kelthane, one of these first-generation miticides that is coming under the gun because of its close relationship to DDT. If this product is removed, makers say, growers will

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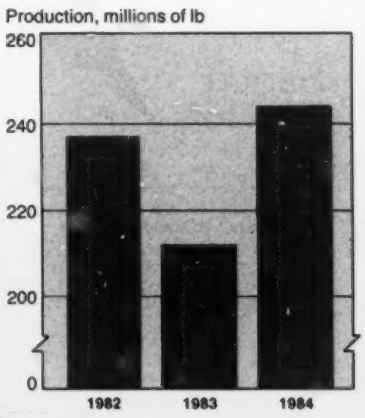
CHEMICAL & ENGINEERING NEWS

Insecticides' fortunes likely will improve this year

Like practically everything else in the agricultural chemical market, insecticides were hit hard by government acreage set-aside programs in 1983.

The crop that hit insecticides hardest last year was cotton, which is also the crop that uses the largest amounts of insecticides. Corn, soybean, and wheat uses of insecticides also were off from the previous year.

About the only good news in 1983 was prices. In spite of the decreased demand for insecticides, the Department of Agriculture says that insecticide prices were about 8% ahead of their 1982 levels.



Like herbicides, insecticides last year also were hurt by the drought in the Midwest and Southeast. The combination of the government's payment-in-kind program and the drought was "drastic" in terms of the insecticide market, according to one producer. As a result, pesticide shipments dropped about 11% last year to about 213 million lb from their 1982 level. Increased prices helped, however, so that the value of shipments was off only about 3% compared with the year before.

This year, though, promises to be different. The Department of Agriculture is forecasting that cotton acreage will be up about 35% to 10.8 million acres from the year-earlier level. This still will be, however, below the 11.4 million acres of cotton planted in 1982. Add to this the large gains in corn acreage and the potential is there for a strong rebound from last year's depressed levels.

Early forecasts from the government call for insecticide production to be up about 10% over last year, but producers are now saying that it may increase more than that.

Producers also say that insecticide inventories, like those for other pesticides, are in good shape. At least they are lower than they were a year ago. Until just recently, however, agricultural insecticides had not started to move from the dealer to the farmer.

Prices this year appear flat, though there is some variation between products. The biggest effect on prices seems to be a huge cut by Shell on its pyrethroid insecticides.

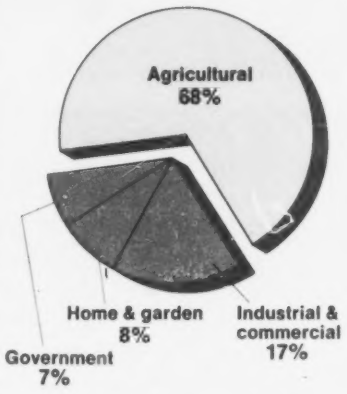
Industry sources say that this price cut by Shell amounted to 25% or more. According to these sources and to industry analysts, Shell lost market share on its pyrethroids last year, and with some new products being introduced by other manufacturers, the company cut the price to regain the lost share of market. Shell declined to talk to C&EN about its insecticide operations.

Exports of insecticides this year are expected to be about the same as in 1983. Exports are a significant part of the business and can account for as much as 50% of production. However, exports of insecticides, like exports of most products, are being hurt by the strong dollar. Insecticide imports, at about 6% of production or less, are not a significant factor in the market.

have to resort to the use of more expensive products.

Another pesticide category that is feeling heat from government regulation is fumigants, which also are expected to recover what they lost last year. However, this is a rather high-volume, low-value area, and one of its leading products, ethylene dibromide, is in the process of being phased out of agricultural uses by EPA (C&EN, Oct. 10, 1983, page 4). According to USDA, the loss of EDB as a soil fumigant will increase nematode control costs and could result in crop losses for some fruit and vegetable producers. The government also says that there are no

Agricultural uses dominate pesticide market



Total 1983 consumption = 1.11 billion lb

Sources: Predicasts, C&EN estimates

readily available alternatives for EDB for quarantine uses. EDB is used for quarantine treatment of fruits and vegetables to prevent the spread of fruit flies.

The other soil conditioners that are expected to do well this year are fungicides. Fungicides producers were hit last year because PIK affected the seed treating of corn. But, by and large, fungicide demand did not seem to suffer so much as some other areas of pesticides. It is growing about 5% per year as more intensive farming is increasing. And farmers also are aware that plant diseases are yield limiting.

The government is predicting only a 2% increase in fungicide production in 1984, but this is largely because of a 23% larger inventory carry-over at the end of 1983 than at the end of 1982. Demand for fungicides probably will be up about 6% this year over 1983. And exports, which can amount to more than one third of production, also are expected to climb about 6%.

This may be the pattern for fungicides for the long run. Predicasts, a Cleveland-based business information and market research firm, says that through 1995, the quantity of shipments of fungicides is expected to grow at about 2.1% per year. However, the firm says that the value of those shipments should grow at about 7.7% per year, reaching $13 billion in 1995. The slowdown in shipments volume, it says, will be the result of a continuation of the development of more concentrated formulations and improved application techniques that will reduce poundage requirements. Predicasts says also that government restrictions on the use of certain commodity toxicants will reduce consumption.

From 1984 through 1995, Predicasts says that prices will grow at an average annual rate of about 5.5%, reflecting higher raw material prices and an industry trend to shift the product mix to higher performance and higher value-added products.

Predicasts also says that U.S. pesticide producers will find their best growth abroad. According to the firm, increasing food production in the developing countries, inadequate foreign pesticide supply, and continued U.S. dominance in pesti-

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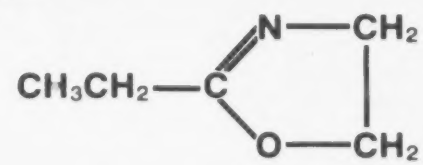

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CIRCLE 51 ON READER SERVICE CARD

Reform bill for regulating pesticides unlikely in 1984

Congress has been trying for well over two years to enact major reforms in the Federal Insecticide, Fungicide & Rodenticide Act, which gives the Environmental Protection Agency its authority to regulate pesticides. So far it has enacted only a simple one-year extension to Sept. 30, 1984.

Part of the problem is the wide-ranging nature of the reforms under consideration. Though they have been strongly endorsed by a coalition of environmental, health, labor, and consumer groups, the reforms have been vigorously opposed by at least 33 farm, business, chemical, and pesticide manufacturing groups. EPA isn't too happy with the proposals either.

The two bills, H.R. 3818 and S. 1774, would set deadlines for retesting pesticides that were approved for use before stricter cancer and genetic mutation tests were required; severely limit special state or local emergency uses of pesticides that have not cleared all of EPA's registration requirements; require that all applicators of restricted-use pesticides be certified; and require EPA to show that a pesticide does not endanger human health before approving its use. The last provision essentially would do away with the agency's ability to use risk/benefit analysis in its pesticide approval process, a procedure that has been strongly endorsed by EPA Administrator William D. Ruckelshaus.

Ruckelshaus recently told the House Agriculture's Subcommittee on Department Operations, Research & Foreign Operations, which last year began marking up H.R. 3818, that what are needed are administrative changes, not legislation. He also said that he believes additional public input is essential for formation of a responsible agency position. To that end he has formed a pesticide advisory panel "to probe the advantages and disadvantages of different legislative and administrative alternatives."

Areas which need to be approached by administrative action include: data quality, improving the registration review process, emergency exemptions from FIFRA, and the need to protect groundwater. Ruckelshaus already has taken steps to increase the number of EPA staffers auditing pesticide test data, and to require private testing laboratories to meet general quality control standards. He also is reviewing the need to ban certain pesticides in areas where they threaten groundwater.

In addition, EPA's newest enforcement policy document outlines a number of priorities for FIFRA. The priorities to be addressed include use problems that EPA and the states have agreed to track; submission of false data for EPA for pesticide registration, and label or formulation violations. In general, the document says that 75% of the office of pesticide programs' inspection resources will be allocated to use problems and 25% to product-related problems. Overall, the strategy reflects EPA's current policy of putting more emphasis on state control programs.

Ruckelshaus' actions, plus the fact that this is an election year (Congress won't want to stay in session too long), probably means that no major reform bill will be enacted this year. The Senate Agriculture Committee last year committed itself to hearings on the reform bill in return for its backers' support of the one-year extension. However, action past that is unlikely. What is likely is another simple six-month or one-year extension of FIFRA, with the more troublesome issues left for the 99th Congress.

cide technology will boost exports to about 836 million lb valued at $5.3 billion in 1995 from about 391 million lb in 1982.

The pesticide industry in the U.S. is one of diversity. Estimates are that more than 400 firms produce pesticides; 25 of these, however, account for more than 80% of pesticide sales. In terms of specific compounds, the industry is much more concentrated. Only a few firms may dominate a particular market, such as postemergent herbicides for soybeans.

Further, entry into these markets may be barred effectively to new producers because of farmers' buying habits. The perceived effective-

Continued on page 54

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CIRCLE 24 ON READER SERVICE CARD

ness of a particular pesticide by the farmer is extremely important, producers say. Since pests may reduce the farmer's income significantly if unchecked, the average farmer is loath to switch from a particular, well-known compound to a less-well-known one.

Further compounding the problem of entry into the pesticide market is the enormous cost of developing pesticides. Estimates are that to develop a single commercial herbicide, 22,000 substances have to be found and investigated. Then after the substance has been developed and its effectiveness proved, it has to go through safety testing for EPA. Thus, the process can take a lot of time and a lot of money. Du Pont estimates that it costs about $45 million in R&D to bring a new pesticide product to market. This compares with about $3 million in the 1950s.

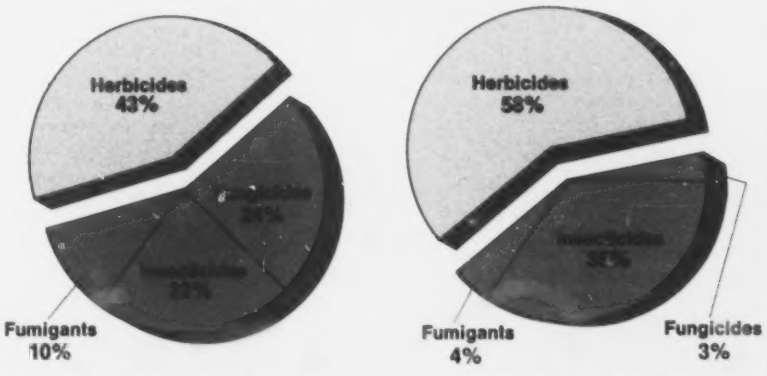
Because of the huge amount of time and money involved, pesticide producers for years have been trying to get changes in the patent laws, allowing them to patent their products later than at the point of discovery. This would allow producers to have longer than seven to nine years of the 17-year patent life in which to recoup their investments.

To counter the problem, producers are taking out use patents, which can describe the method of application or how the product may be used. In this way they can add longer patent life to the product.

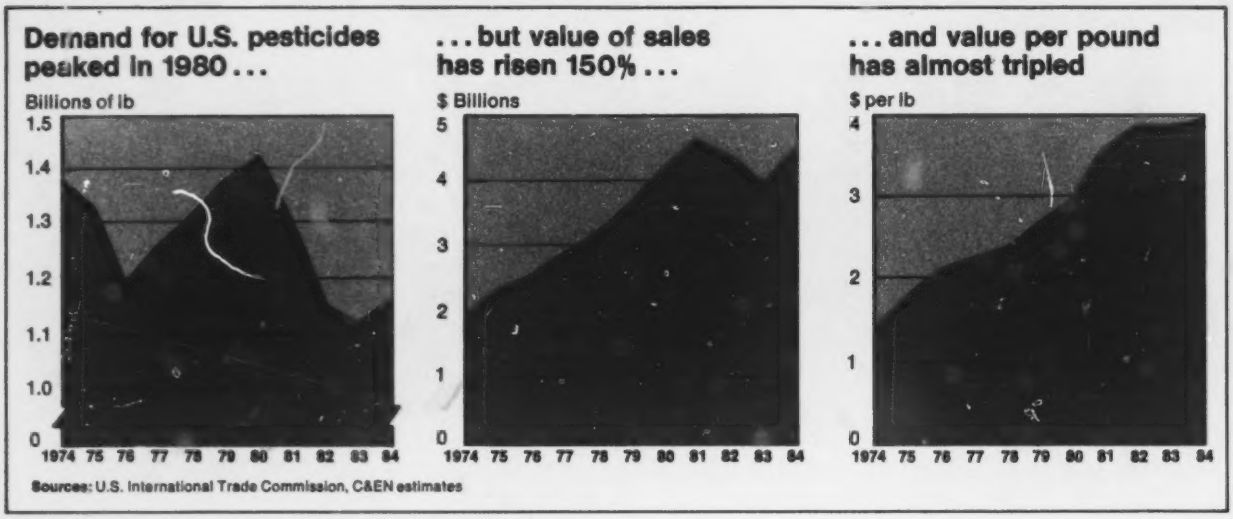
Greenhouse tests are important part of pesticide research at Monsanto's agricultural research division

Coupled with the patent problem and the high cost of entry into the marketplace are the generic producers. These are manufacturers who take products that are no longer protected by patents, and make and

Herbicides account for less than half of pesticide shipment volume, but almost 60% of value



Sources: Predicasts, C&EN estimates



sell them at the generally lower prices that prevailed while the product was still protected. To counter the generic producers, the original manufacturer must lower its price to remain competitive. Thus, it becomes imperative that the original producer recoup its investment during the life of the patent.

Another factor affecting the pesticide market is the change in farming practices over the past few years. With these changes have come shifts in pesticide use.

One of the biggest changes in farming practice has been in tillage. Instead of plowing, harrowing, and then planting a field, farmers have reduced their tillage, and thus the number of trips through a field, to a minimum. Today tillage prior to

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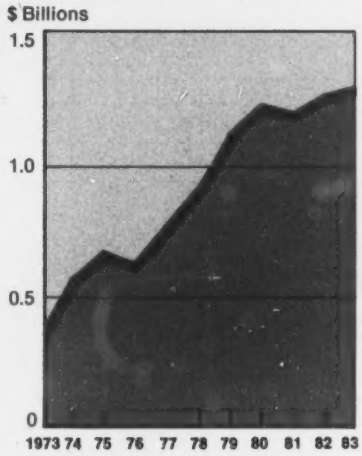
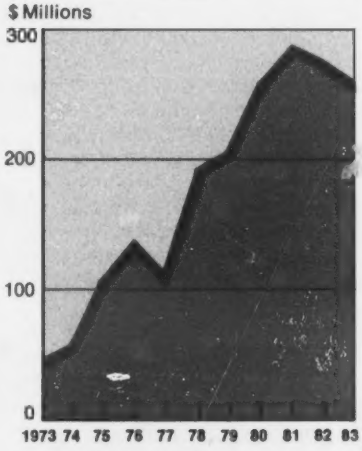


. . . while imports have fallen off . . .



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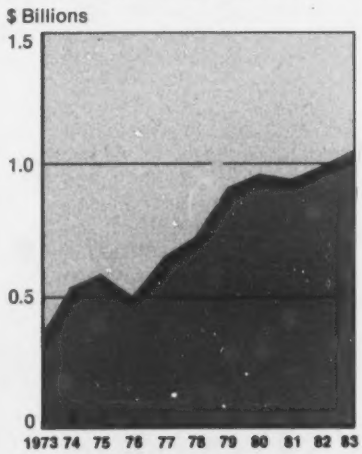

Source: Department of Commerce

planting amounts to little more than breaking up the compaction of the soil in some way.

This no-till or reduced-till farming is basically a conservation practice. It leaves more plant residue or trash on the field, which reduces soil loss, increases soil moisture levels, and lowers soil temperatures. In addition, since it lowers the number of trips that a farmer must make through fields, it saves time and money in terms of wages and gasoline.

Because it is not possible to use standard cultivation techniques when no-till or even minimum-till farming is practiced, the use of herbicides increases. This is because there is a mat of debris remaining on the soil and therefore mechanical cultivators won't work. To rid the fields of weeds after the crop has emerged, herbicides must be used. There also is an increased use of herbicides prior to planting since weeds are not killed by plowing.

In a survey of 10 major producing states USDA found that about 12.7% more pounds of herbicides were used per acre in reduced-till farming than in conventional tillage farming. And in no-till practice, 16.7% more herbicides were used per acre.

Thus far corn is the main target of no-till planting. Soybeans have presented a problem because the farmer must have absolute weed control before planting. This is necessary because soybeans, being a broadleaf plant, are killed by many of the herbicides that are used. Herbicide producers say that they are, however, overcoming this problem and effective, specific postemergent herbicides for soybeans will be ready soon. Reduced-till practices are more prevalent in soybeans than are no-till.

Conservation farming is just one example of the types of innovation that farmers are practicing and that will continue to fuel pesticide growth over the next several years. Farmers must make use of every tool available to assure that their crops will flourish and pesticides are one of those tools. As one producer says, "Pesticides do nothing more than offer the farmer insurance." □

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